MONTHLY NOTICES

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ROYAL ASTRONOMICAL SOCIETY.

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Dr. LEE, President, in the Chair.

Major J. T. Walker, India;
H. M. E. Crofton, Esq., Inchinappa, Co. Wicklow;
Arthur J. Melhuish, Esq., 26 Haymarket; and
Richard Munday, Esq., R.N., Dockyard, Malta,
were balloted for and duly elected Fellows of the Society.

Observations on Saturn. By Wm. Wray, Esq.

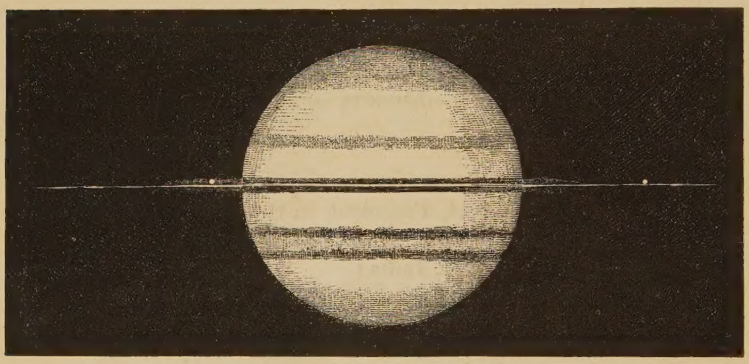
Telescope 7 inches clear aperture; $8\frac{1}{2}$ feet focus.

1861, Dec. 17th, at $18^h\ 30^m$. On turning the telescope on *Saturn*, to my utmost surprise, with power 110, I instantly perceived the whole of the edge of the ring, not only where it crossed the dark shade on the body, but also extending on each side of the planet's margin. It was irregularly broken.

Dec. 23d, $17^h\ 20^m$. The edge of the ring again seen distinctly, and suspected to be thicker and somewhat nebulous about the region on either side, where it joined the planet's limb.

Dec. 26. Atmosphere very fine, and the image of *Saturn* exquisitely steady and well defined. The northern equatoreal belt was observed to consist of two narrow dark grey bands, connected by a broader region of a light brown colour: it thus had the appearance of being double. At $16^h\ 30^m$, the eastern arm of the ring was scarcely visible, whilst the western could not be overlooked, and was broken in two places. The

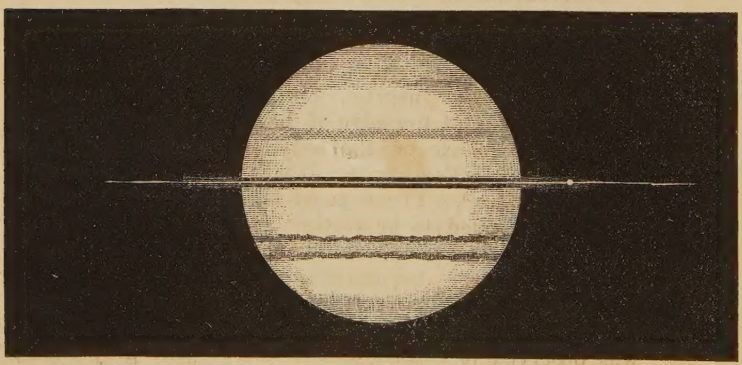
brightness of the eastern arm gradually increased; and at $18^h\ 30^m$ both were sensibly equal in light. At 19^h the eastern arm surpassed the western, and disappeared last in the twilight. A prolongation of very faint light stretched on either side from the dark shade on the ball, overlapping the fine line of light formed by the edge of the ring, to the extent of about one-third its length, and so as to give the impression that it was the dusky ring, very much thicker than the bright rings, and seen edgewise, projected on the sky. At $18^h\ 30^m$ I made the rough sketch, No. 1.



No. 1. 1861, Dec. 26, at $18^h\ 30^m$; two Satellites on the ring.

1862, Jan. 4th, $18^h\ 40^m$. Western arm much broken and brighter than the eastern, the faint overlapping light again seen.

Jan. 5, $13^h\ 30^m$. Edge of the ring well seen. Sketch,



No. 2. 1862, Jan. 5, at $14^h\ 0^m$; one Satellite on the ring.

No. 2, was made at 14^h; the faint overlapping light was exceedingly distinct at this time. The western arm of the ring

much fainter and shorter than the eastern, which was proved by its becoming invisible on raising the power from 110 to 450, the eastern arm remaining visible under the latter power. At $16^h\ 40^m$ the arms were judged to be equal in length and brightness, and both visible with power 450. At $17^h\ 15^m$ and until $18^h\ 0^m$ the western arm was decidedly the brightest.

Jan. 11th, $14^h\ 0^m$. The edge of the ring again well seen, and the faint light before referred to unmistakeably visible.

Jan. 18th, $13^h\ 30^m$. The edge of the ring broken, and the arms equal in brightness and length; faint light again clearly perceived near the planet's margin.

Shortly after these observations the instrument was sent to Archdeacon Garbett, of Clayton, in Sussex; and on the 19th of May, at $10^h\ 30^m$, that gentleman and his sons clearly perceived the whole of the edge of the ring of *Saturn*.

The fine thread of light seemed to me always of a bluish-white tinge, very different in colour to the ball of the planet. The inner satellites were frequently perceived moving along the fine line of light; *Mimas* distinctly on two occasions.

1 *Clifton Villas, Highgate Hill, Upper Holloway.*

On the Observations of Saturn made at Pulkowa and Greenwich. By the Astronomer Royal.

A paper has lately been received from M. Otto Struve, dated 1862, July 2, containing numerous details on the appearances presented by *Saturn* about the time of disappearance of his ring in May of that year.

It is not my intention here to transcribe the whole of M. Struve's observations. I shall only remark that M. Struve considers himself justified, by the views which he as well as M. Winnecke obtained with the Pulkowa Refractor, in assuming the existence of certain appendages (*appendices lumineux*) which are not the same as the ansæ of the ring.

No such idea suggested itself to the observers with the Greenwich Equatoreal.

I have requested Mr. Carpenter to draw up an account of his observations, and I ask leave to place them before the Society in juxtaposition with extracts from the remarks of M. Otto Struve. On the whole the accordance is good.

It will be remembered that "left" in Mr. Carpenter's language corresponds to "preceding" in M. Otto Struve's.

J. C.

1862. May 5.

Right ansa longer by $\frac{1}{10}$ than the left.

May 13.

Ring of a dirty copper colour.

(A drawing was made.)

STRUVE.

1862. May 15.

The line of ansæ perfectly well visible. On the north side it is more glittering, and limited by a sharp edge. On the south side, on the contrary, it appears as if clouds of a less intense light were lying on the ansæ.

On the body of the planet the obscure ring is visible, but I cannot see traces of the above-mentioned clouds.

Measures of Ansæ.

Preceding, 11″·07;
following, 10″·35.

May 16.

Preceding ansa without doubt longer than following ansa in the proportion of 5 to 4.

May 17.

The ring beyond the planet at times just visible on the left of the disk, but on the right only a small faint spot could be seen in the plane of the ring, about $\frac{1}{3}$ the diameter of the disk from the planet's limb. I should have suspected this was a satellite but for its elongated shape.

Sky very hazy.

May 17, 15^h.

The preceding ansa estimated to extend 11″·4, or at most 13″·3 beyond the planet.

The light of the preceding ansa is of the colour of rose copper, and considerably stronger on the side touching the planet.

(Computed time for disappearance of ring, May 17^d 19^h.)

May 18.

I see the ansæ distinctly; they offer the same appearance as yesterday.

May 19.

Saturn very well seen. The ring distinctly visible on the left of the disk; and fairly, but not so distinctly visible on the right. Where it crosses the disk the under edge is much sharper and better defined than the upper edge.

(A drawing was made.)

May 19.

I see distinctly traces of the ring, especially on the preceding side.

The luminous appendages extend on the preceding side to 0·6, and on the following side to 0·3 of the diameter of the planet.

Their colour differs much from the ordinary colour of the ring. They are not yellow, but more of a livid colour, brown, and blue.

May 20.

Saturn very well seen; the ring distinctly visible, appearing brighter than it did last night.

(The drawing made last night may be considered as a fair representation of the planet's present appearance.)

May 20.

The aspect of the luminous appendages has not varied since last night, with this difference only — that I estimated the length of the preceding side as 0·65, and the following as 0·5 of the planet's diameter.

May 21.

Images good.

Estimated extent of luminous appendages: — Preceding side 0·6, following side 0·4, of the planet's diameter; also the intensity of the light appears much more feeble on the following side. The size of these appendages increased in the neighbourhood of the planet, giving them the form of sharp wedges.

May 22.

Images less favourable than yesterday. Extent of luminous appendages on preceding side 0·6, on following side 0·5 of the planet's diameter.

May 25.

The ring still just visible.

June 1.

The ring still visible during moments of good definition.

June 3.

Saturn well seen. The ring very plainly visible. During moments of very good definition I fancy I can see the flat surface of the ring very faintly illuminated.

June 3.

Image very bad, yet the luminous appendages are still distinctly visible. It appears that the length of the following ansa is a little the greater, but this is not certain.

December 22, 1862.

Mr. Joynson communicated to the Society a series of thirty-six drawings of *Mars*, taken at Waterloo, near Liverpool, Lat. 53° 28′ 24″ N., Long. 3° 1′ 44″ W., accompanied with the following explanation: —

The diagrams are selected from a considerable number of drawings of the planet *Mars*, about the time of his opposition, and extend from the 25th of Sept. to the 10th of Nov., 1862. They were taken with a lens of $3\frac{1}{2}$ inches aperture, and a power of 370, both lens and eye-piece being made by Messrs. J. Cooke and Sons, of York. They are arranged so as to show the appearance of the planet during the whole time of its rotation, and a few are repeated so as to show that the aspect of the planet was not changed during the time the observations were continued.

The results of the observations appear to be,—

1st. That the band is continuous round the planet, with the exception of the place where the pale yellow stripe crosses it, as marked in the diagram of 5 October.

2nd. That the snow at the south pole is not exactly on the axis of rotation.

3rd. That the time of rotation is $24^h\ 37^m\ 49^s$.

No opinion is offered as to the permanency or otherwise of the band, but it is found that the disk continues (Nov. 1862) to show the appearances that it did at first, so that there is no difficulty in knowing what part has passed and what has to be seen later in the night.

The general colour of the planet (beside the band) was yellow, save a part in the northern hemisphere, seen between the 12th and 24th October, which was reddish. Sometimes the band had a dead greenish cast, and sometimes it was of a purplish line, but in the main it was very dark. On the 26th October the opening from it appeared to extend very nearly to the snow at the south pole, and then to form a darkish semicircle about it.

It may be remarked, that in general the northern hemisphere to the northern edge of the band has been the best to define, whereas the southern hemisphere has mostly been rather indistinct, and the yellow colour less perceptible than in the northern. The small circle on each diagram marks the position of the snow.

The planet has now become gibbous, and is both smaller and worse to define with the same eye-piece than when the observations were commenced.

The telescope is equatoreally mounted, and was driven by clockwork during the observations.

The eye-piece was the ordinary Astronomical Inverting kind.

Liverpool, 18th Nov. 1862.

Note on U *Geminorum.* By J. Baxendell, Esq.

On the night of 26th Dec. 1862, I was surprised to find U *Geminorum* shining as a star of the $10\frac{1}{2}$ magnitude, although, according to calculation, it ought at that time to have been nearly in the middle of its phase of minimum brightness, and therefore below the 14th magnitude; but on the 29th, and again on the 30th, it was invisible in a sky which permitted stars of the $12\frac{1}{4}$ magnitude in the immediate neighbourhood to be seen. The maximum must therefore have occurred previous to the 26th; and fortunately, owing to the kindness of Mr. Knott, I am enabled also to state that it was subsequent to the 20th. In a letter from this careful observer, dated January 6, 1863, he says, "I was not fortunate enough to obtain any observations of the recent unexpected maximum of that *most eccentric* variable, U *Geminorum*. I find from my journal, however, that I *looked for it* on December 20th, *but to no purpose*, though Mr. Pogson's '*g*' and '*h*' were well in view. The night was but indifferent, but I think we may safely assume the variable to have been below 12·3 or 12·5 mag." Mr. Knott also remarks that his observation, combined with mine, seems to show that either the changes were *very rapid*, or that the maximum was *rather a faint one*.

The occurrence of this maximum is, I believe, the greatest deviation from the usual course of the changes of U *Geminorum* that has yet been observed; and it shows very strikingly the importance of keeping a constant watch over variables of this class. It also shows the necessity of a material modification of the elements derived by Mr. Pogson from the early observations of this Star.

With reference to Mr. Knott's remark, "that either the changes were *very rapid*, or that the maximum was *rather a faint one*," it may be observed that a maximum of equally short duration occurred in November, 1858. On that occasion the variable attained the 9·3 magnitude, and yet the whole time of visibility with ordinary telescopes did not exceed *nine* days.

Manchester, January 8, 1863.

On the Elchies Equatoreal. By G. Knott, Esq.

Mr. Knott, in a letter dated Woodcroft, Cuckfield, Jan. 8, 1863, after referring to the quadruple star 222 P. I. *Arietis* (one of the objects examined by the Astronomer Royal for Scotland with the Elchies Refractor), writes as follows:—

"It has occurred to me, however, that it may not be uninteresting to the Members to learn that all four components of that group are very readily (I had almost said easily) visible in my $7\frac{1}{2}$-inch Alvan Clark refractor, and that I should be inclined to attribute (as has been remarked by Mr. Dawes) any difficulty in catching up the small star 'B' less to its faintness than to its proximity to the brighter star 'A.' We have an illustration of this same principle in the case of the celebrated 'sixth star' in the nebula of *Orion*, for securing which sharp definition is far more necessary than great light in a telescope.

"From observations on Dec. 10, 12, 15, 20, I estimate the magnitudes of the members of the group (222 P. I.),

A 9·4 : B 11·3 : C 10·1 : D 6;

or reducing to Prof. Struve's scale (which is also that of Mr. Dawes),

A 8·5 : B 9·9 : C 9·1 : D 6

"A comparison of these with Mr. Dawes' values seems to indicate that I have rated them rather too high. A and C, however, accord well with Σ's estimates in the *Mens. Microm.*

"A rough set of wire-micrometer measures, on Dec. 12, yielded the following results, which are, of course, approximate merely:—

AB	Angle of Position	$50^{\circ} \pm$	Distance	$2\frac{1}{2}'' \pm$	Estimated.
AC	—	166·4	—	37·3	
AD	—	360·8	—	133·6	

"By differentiating D with *β Arietis*, I at once recognised it as the star observed by Piazzi (*Hora* i. No. 222), and was not long in coming to the conclusion that, somehow or other, the magnitudes of A and D in the *Bedford Catalogue* had been interchanged. This little oversight being rectified, the magnitude values of the various meridian and extra-meridian observers are found to be in admirable accordance, and the invariability of the group settled apparently beyond a doubt."

Observations of Comet II. 1862, *taken at the Observatory of J. Gurney Barclay, Esq., at Leyton, Essex, and communicated by him.* By Hermann Romberg.

The following observations of Comet II. 1862 were taken with the ring-micrometer on the large Refractor, and are corrected for refraction and parallax:—

1862.	G.M.T. h m s	Comet's R.A. h m s	Comet's Decl. ° ′ ″	
July 31	10 53 28·8	5 54 13·92	+73 2 36·4	*a*
Aug. 1	13 1 31·2	5 58 56·46	73 39 19·1	*b*
3	12 44 8·5	6 9 25·21	74 52 0·3	*c*
5	9 25 37·0	6 22 17·11	76 4 58·8	Meridian.
7	9 38 38·5	6 41 30·61	77 31 38·7	*d*
14	11 15 55·6	9 46 35·95	82 0 29·3	*e*
15	12 3 3·9	10 38 50·71	81 55 3·0	*f g*
18	8 55 32·3	12 54 24·60	79 8 42·1	*h*
,,	9 4 17·9	12 54 37·06	79 8 7·7	*i*
22	9 29 10·3	14 35 48·21	68 58 10·7	*k*
,,	12 28 53·4	14 37 43·63	68 32 13·3	*l*
23	10 56 23·3	14 50 38·49	65 7 29·6	*m*
24	12 30 54·0	15 2 44·51	60 46 22·6	*n*
,,	13 21 2·8	15 3 6·47	60 37 19·0	*o*
,,	14 4 2·4	15 3 23·50	60 29 35·3	*o*
25	10 57 50·8	15 11 32·73	56 32 40·7	*p*
,,	11 30 52·4	15 11 44·36	56 26 4·9	*q*
27	12 16 19·9	15 26 37·13	46 0 31·0	*r*
28	11 55 26·4	15 32 33·15	+40 13 14·4	*s*

Mean Places of the Stars of Comparison for 1862·0.

	R.A. h m s	Decl. ° ′ ″	
a	6 1 15·42	+72 59 17·0	Arg. Zon. and Radcl. Cat.
b	6 0 11·71	73 45 11·0	A. Z.
c	6 4 39·03	74 53 38·3	,,
d	6 41 33·51	77 24 22·7	,,
e	9 17 8·06	81 55 53·5	Radcl. Cat.
f	10 26 29·11	81 51 16·1	Redhill Cat.
g	10 28 8·04	81 57 11·1	,,
h	12 51 46·93	79 14 51·3	A. Z.
i	12 56 29·83	79 10 56·9	,,
k	14 35 27·52	69 2 45·5	,,
l	14 36 25·48	68 37 1·8	,,
m	14 51 50·93	65 12 24·4	,,
n	14 58 13·51	60 44 51·1	Radcl. Cat.
o	15 0 13·46	60 33 51·7	,,
p	15 10 2·56	56 38 2·6	,,
q	15 12 20·76	56 31 10·2	A. Z.
r	15 27 18·48	46 6 6·2	,,
s	15 31 2·81	+40 17 15·3	Radcl. Cat.

I watched with great interest the very remarkable pheno-

mena presented by the nucleus, but was unable to take measures of the luminous streamer on account of the wire-micrometer being unfortunately under repair.

Mr. G. Barclay's observatory is situated at Leyton, in Essex, in longitude $0^h\ 0^m\ 0^s{\cdot}8$ W., and latitude $51°\ 34'\ 34''$ N. This determination was obtained by Mr. John Worden, by connecting it with a point in the Trigonometrical Survey close at hand. The instruments are a fine Refractor, by Cooke and Sons, of York, of 10 inches aperture and 12 feet focal length. The mounting is upon the well-known German principle, and unites beauty of workmanship with great firmness and solidity. To the Refractor is attached a spider-line and double-image micrometer, the former being chiefly intended for measures of double stars. In order to facilitate these measures, an excellent driving-clock by the same maker was added in the past summer, which has given perfect satisfaction. It is proposed to measure, as far as practicable, the stars in W. Struve's last Pulkova Catalogue, Bessel's selected list, the known revolving double stars, and a number observed by Admiral Smyth in the Bedford Cycle. Observations of the fainter Small Planets it is hoped to procure, with a new wire-micrometer provided with illuminated wires in a dark field.

The Observatory contains also a Meridian-Circle by Troughton and Sims, the telescope having an aperture of 4 inches and focal length of 4 feet; the circles are 3 feet in diameter, divided to every five minutes, and read by four microscopes. The inclination of the instrument is determined by a level, and the errors of azimuth and collimation by observing northern stars and reversing. I hope to make a good use of this instrument, not only for the common determinations of time, longitude, and latitude, but for observations of Planets, and later for ascertaining the positions of Comparison-Stars.

The Sidereal Clock is by Simmons, and has a very satisfactory rate. In September and October I obtained some observations of *Mars* in opposition, using also the method recommended by the Astronomer Royal. The weather, however, was generally unfavourable. Since that time I have carefully examined the screw of the wire-micrometer, and have now measures of about 80 double stars, in part of which the double-image micrometer was employed. It is right to state that the mounting of the instruments was superintended by Mr. John Worden.

J. Gurney Barclay's Observatory,
Leyton, January 4, 1863.

Observations and Elements of Comet II., 1862.
By J. Tebbutt, Esq.

Mr. Tebbutt, in a letter dated Windsor, New South Wales, October 20th, 1862, writes:—

"I herewith enclose my latest observations of a large Comet which suddenly made its appearance here on the evening of the 1st September. The observations were made with a telescope of $3\frac{1}{4}$ inches clear aperture, and 4 feet focal length, provided with a ring micrometer diameter 20′ 50″. They are not so accurate as I could wish, owing to the faint and diffused light of the comet during the present month; they will, however, prove useful in the event of the comet not being more accurately observed elsewhere. The Rev. W. Scott resigned some time since his appointment as Director of the Sydney Observatory, but some observations have been made of the Comet by his assistant. I believe, however, they are not in a state to be forwarded to Europe by this opportunity. The physical changes of the Comet during the early part of September were very remarkable, for a brief notice of which I beg to refer you to a paper read by me before the Philosophical Society of this colony on the 8th instant. The paper is published in the *Sydney Morning Herald* of the 9th instant, a copy of which I forward with this letter. I have deduced the following elements from observations extending from the 1st September to the 15th instant.

Perihelion passage, 1862, August 23^{d}·1340 Greenwich Mean Time.

Perihelion distance	0·96290	
Distance of perihelion from ascending node in the direction of motion	152° 49′ 48″	
Longitude of ascending node	137 13 36	Mean Eq. of 1 Jan. 1862
Inclination of orbit	66 9 36	

Motion retrograde.

The most remarkable feature of the Comet's orbit is its near approach to the Earth's path at the descending node; according to my calculations the distance between the two orbits at that point is only half a million of miles. This Comet cannot be identical with that discovered by M. Tempel at Marseilles on the 2d July.

1862.	Greenwich Mean Time. h m s	Star of Comparison.	Comet — Star. R.A. m s	N.P.D. ′ ″
Sept. 19	21 49 48	B.A.C. 5538	− 8 34·2	− 3 4
	22 13 7	,, ,,	− 8 33·4	− 1 57
	22 37 29	,, ,,	− 8 3·4	− 0 55

1862.	Greenwich Mean Time. h m s	Star of Comparison.	Comet — Star. R.A. m s	N.P.D. ′ ″
Sept. 25	23 27 28	B.A.C. 5593	−11 16·1	−11 43
26	0 7 2	,, ,,	−11 12·6	−11 20
	22 5 51	,, 5583	− 9 30·3	+ 9 6
	,,	,, 5584	− 9 38·3	+ 9 26
	22 21 15	,, 5583	− 9 30·4	+ 9 18
	,,	,, 5584	− 9 38·6	+ 9 29
Oct. 3	21 59 27	Brisbane 5754	+ 5 1·3	
	,,	,, 5799	− 1 37·3	
	22 6 10	,, ,,	− 1 36·5	− 3 16
	22 18 17	,, 5754	+ 5 3·7	+ 5 58
9	21 47 59	*a*	+ 0 26·6	+12 22
	,,	*b*	− 2 11·6	+15 4
	21 54 41	*a*	+ 0 26·5	+12 14
	,,	*b*	− 2 11·6	+15 3
	22 7 33	*a*	+ 0 27·1	+12 21
	,,	*b*	− 2 11·4	+15 10
	22 15 3	*a*	+ 0 26·1	+12 47
	22 19 30	*a*	+ 0 25·6	+12 45
	22 23 46	*a*	+ 0 26·6	+12 36
	22 29 45	*a*	+ 0 25·8	+12 38
	22 34 37	*a*	+ 0 24·6	+12 42
			a — B.A.C. 5472	
			+17 36·7	+ 8 3
			b — B.A.C. 5472	
			+20 14·1	+ 5 11
12	21 40 32	Lacaille 6907	+ 7 8·2	
	,,	B.A.C. 5558	+ 6 32·3	
	21 52 10	Lacaille 6907	+ 7 10·7	+11 40
	,,	B.A.C. 5558	+ 6 35·2	+11 7
14	21 19 20	,, 5561	+ 8 2·6	− 2 7
	,,	*c*	− 0 47·1	+16 25
	21 32 38	B.A.C. 5561	+ 8 4·0	− 2 31
	21 45 2	,, ,,	+ 8 5·3	
	21 56 40	,, ,,	+ 8 2·8	− 1 49
	,,	*c*	− 0 48·6	+16 42
	22 9 37	B.A.C. 5561	+ 8 5·8	− 1 49
	,,	*c*	− 0 44·1	+16 42
			c — B.A.C. 5561	
			+ 8 50·4	−18 31
			c — Brisbane 5850	
			− 1 23·0	+11 1

Long. of place of observation	$10^h\ 3^m\ 42^s$	East of Greenwich
Lat. of place of observation	33° 36′ 30″	South

Remarks.

Where the difference of N.P.D. is not given it is to be understood that one of the objects crossed the ring near its centre. The stars *a*, *b*, are of the 7 mag., and *c* of the 7·8 mag. B.A.C. 5558 is double; the *following* star was employed in the comparisons of the 13th October. The following are the mean places of B.A.C. 5538 and 5583 from observations made at the Sydney Observatory.

B.A.C. 5538, January 1, 1859, R.A. $16^h\ 27^m\ 6^s{\cdot}44$, N.P.D. 124° 57′ 39″·4 from six observations in 1859.

B.A.C. 5583, January 1, 1860, R.A. $16^h\ 34^m\ 3^s{\cdot}41$, N.P.D. 130° 50′ 49″·6 from one observation in 1860.

Places of Comet II. 1862, *observed at Armagh.*

By N. M'N. Edmondson, Assistant at the Observatory.

(*Communicated by Dr. Robinson.*)

1862.	Greenwich M.T. h m s	R.A. h m s	s	N.P.D. ° ′ ″	″
Aug. 27	11 6 36·49	15 26 18·27	$+\varpi\times$0·05596	43 41 54·28	$-\varpi\times$0·52008
28	9 16 17·63	15 31 41·87	0·04292	48 52 52·70	0·39972
29	9 4 21·21	15 36 46·30	0·04231	54 41 45·17	0·46049
31	9 32 36·89	15 45 8·31	0·03666	66 38 39·70	0·63061
Sept. 1	8 52 44·77	15 48 33·28	0·03132	72 14 58·45	0·66010
7	8 44 41·06	16 3 10·20	0·03038	99 50 47·09	0·86420
8	8 36 46·11	16 4 52·93	0·03009	103 7 5·87	0·87828
9	8 32 25·68	16 6 59·92	$+\varpi\times$0·03019	105 57 15·46	$-\varpi\times$0·88794

	Comparison Stars.	Comparisons.	Assumed Places.
Aug. 27	Lalande 28208	5	Lalande.
28	52 Boötis	5	Armagh Catalogue.
29	P. xv. 148	6	R.A. from P., N.P.D. from Armagh.
31	Lalande 28875	4	Lalande.
Sept. 1	P. xv. 203	6	R.A. from Armagh, N.P.D. from P.
7	15 Scorpii	5	Ditto ditto B.A C.
8	Lalande 29671	5	Lalande.
9	Argelander Zone 297, No. 76*	6	Argelander.

* I am indebted to Mr. Ridings, of Markree, for the name and places of this star. Its identity with the comparison star seems doubtful. The comet preceded the star in R.A. $4^s{\cdot}25$, and was north of it 5′ 42″·08.

Results of the Meridional Observations of Small Planets, and an Occultation of a Star by the Moon; observed at the Royal Observatory, Greenwich, in the month of December, 1862.

(*Communicated by the Astronomer Royal.*)

Themis (24).

Mean Solar Time of Observation.		R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1862, Dec. 1	10 27 32·5	3 9 36·10	71 52 6·81
13	9 32 45·4	3 1 58·70	72 21 20·07

Urania (80).

Mean Solar Time of Observation.		R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1862, Dec. 1	13 13 7·1	5 55 37·90	63 44 12·28
10	12 28 9·1	5 46 1·55	63 51 29·48
11	12 23 5·2	5 44 53·37	63 52 41·11
13	12 12 56·2	5 42 35·81	63 55 9·49
23	11 22 17·2	5 31 14·04	64 12 10·92
29	10 52 29·7	5 25 0·97	64 24 51·72

All the observations of N.P.D. have been corrected for Refraction and Parallax.

Occultation of α Cancri by the Moon.

Observed on Dec. 10, by Mr. Criswick. The disappearance took place at the Moon's Bright Limb at $15^h\,54^m\,54^s{\cdot}8$, and the reappearance at the Dark Limb at $17^h\,4^m\,46^s{\cdot}9$ M.S.T.

Observations of Asia (67), *taken with the Equatoreal of the Liverpool Observatory.* By J. Hartnup, Esq.

1862.	G.M.T	R.A. (67)	Log. $\frac{p}{P}$	N.P.D. (67)	Log. $\frac{q}{P}$	Star of Comp. B.A.C.
	h m s	h m s		° ′ ″		
Dec. 10	9 50 43·4	3 34 14·84	−7·829	77 6 15·2	−9·8114	1241
10	10 20 37·7	3 34 13·76	−7·154	77 6 19·4	−9·8104	,,
10	10 50 32·0	3 34 12·51	+7·592	77 6 23·2	−9·8105	,,
11	10 23 55·2	3 33 28·76	..	77 9 15·0	−9·8108	,,
11	10 53 49·7	3 33 27·42	+7·727	77 9 17·5	−9·8114	,,
17	9 56 20·9	3 29 30·02	..	77 24 1·3	−9·8130	1087
17	10 11 18·4	3 29 29·39	+7·426	77 24 2·3	−9·8130	,,
17	10 26 16·2	3 29 29·02	+7·726	77 24 4·1	−9·8136	,,

The observations are corrected for refraction. The corrections to be applied for parallax in time and arc are represented by p and q. P is the equatoreal horizontal parallax.

The following are the assumed mean places of the stars of comparison for 1862, January 0:—

	R.A.	N.P.D.	Authority.
	h m s	° ′ ″	
B.A.C. 1241	3 53 2·34	77 54 9·45	Greenwich Observations.
,, 1087	3 23 15·49	77 32 20·39	,, ,,

Mr. Warren De La Rue exhibited at the January Meeting a photograph of the Moon, taken near the dichotomy, enlarged so as to correspond in size with the map published by Beer and Mädler, and called the attention of the Fellows to the great progress which has been already made in Photographic Selenography.

Mr. De La Rue stated that, when he first commenced to map the lunar surface, the only way of procedure possible in the then state of the photographic art was, after the original negative had been taken, to place it under the microscope, and make, with the aid of the camera lucida, an enlarged copy of such portions of it as might be required by hand. Latterly, however, a more direct method has been discovered, by means of which, as Mr. De La Rue pointed out to the Meeting, the magnificent photograph enlarged thirty-eight times from the original negative had been produced. In the first instance a positive on glass was obtained, nine inches in diameter, from the original negative of one inch in diameter; and at the second operation a series of negatives were procured on a scale of thirty-eight inches for the Moon's diameter.

Mr. De La Rue, while bearing full testimony to the valuable labours of MM. Beer and Mädler, pointed out that their map did not give a true representation of the lunar surface as a chart, it only *mapped* it, while the photograph does both; and, although the latter might not be quite so sharp in its outlines as might be wished, still one must be contented to lose something in exchange for the great magnification of the negative. The combination of favourable circumstances necessary for the production of a perfect photographic picture was then alluded to. Atmosphere, collodion, instrument, driving-clock, all must be perfect; and the very rare occasions on which this combination occurs may be judged of from the fact that of four hundred negatives taken by Mr. De La Rue during the last five years, about twenty only are capable of producing a perfectly sharp photographic record; the tremulous motion in the

image from atmospheric defects being the *main* cause of the difficulty.

Turning to another allied subject, the photographs of the Solar Eclipse, Mr. De La Rue referred to certain discrepancies (to which he had alluded in his Bakerian Lecture on the Total Solar Eclipse of 1860, read before the Royal Society), between the photographs taken by Father Secchi and his own, and stated that, on a recent visit to the Roman Observatory, he remarked a photograph differing considerably from those which have been distributed in this country, by the kindness of Señor Aguilar, who had accompanied Father Secchi. Father Secchi's copy bore a very much greater resemblance to Mr. De La Rue's than these latter; and, upon inquiry, he found that after the first few positives had been taken from the original negatives, they had been subjected to a process technically called "strengthening," which, in this instance, had completely blotted out all the minute detail at first recorded.

While Mr. De La Rue was in Rome, Father Secchi's copy of the first place of totality was enlarged, and he brought back with him to England a negative corresponding in size with those taken with the Kew Heliograph by himself; and he has found, on tracing both and comparing the tracings, that the similarity is complete, with the exception that two luminous prominences are seen in Father Secchi's photograph which were not visible from Mr. De La Rue's station; that is, the only discrepancies between the two photographs taken at the two stations could be explained by the greater covering of the Sun in the one or other direction by the parallax of the Moon, dependent on the observers' positions, with respect to the central line of the eclipse. J. N. L.

Memorie Astronomiche. Del Prof. Donati. (Published in the Annals of the Museum at Florence, 1862.)

(*Abstract by S. M. Drach, Esq.*)

The first memoir, dated August 1860, is on the Striæ of Stellar Spectra. After quoting Fraunhofer, in Schumacher's *Astron. Abhand.*, Part ii., 1823, and in Gilbert's *Annalen der Physik* (vol. lxxiv., 1823), on the spectra of stellar and planetary light rays, the author states that he used a large burning lens kept in the Museum since 1690, and whereon Targioni, Averani, and Sir H. Davy had experimented. This lens has a diameter of 0·41 metres, and a focal distance of 1·58 metres (15 and 62½ inches). The lens was mounted parallactically on a movable stand: a piece with a fine slit was placed a short distance within the focus of the lens, through which the stellar rays passed. Within this lens-tube

is a cylindrical lens with its very short focus, coinciding with that of the great lens. The stellar ray then falls on a prism fixed on a graduated circle, to which is attached a small achromatic telescope (object-glass, aperture 0·024; focal distance 0·17 metre; eye-piece magnifies 12 times). There is also at the end of the great lens-tube an achromatic lens equal to the object-glass of the telescope. Thus the stellar rays are passed through the cylinder-lens, the tube-achromatic, the prism, and the telescope-lenses before reaching the observer's eye. In the focus of the achromatic telescope are two metallic bars, one fixed, the other movable by a micrometer-screw. A cylinder-lens was preferred to a simple slit, for the purpose of getting the two lateral segments of the fasciculus of rays, which are lost in the ordinary diaphragm. But as by changing the position of the star observed, as respects the direction of the optical axis of the collecting lens, we change the position of the focal straight line produced by the cylindrical lens, making it impossible to keep the said straight line always in the same position as regards the prism, the author placed a metallic lamina at a distance from the cylinder-lens, equal to the focal distance of the latter. In the said lamina is a thin longitudinal slit, through which one sees the light-line formed in the focus of the cylinder-lens; thus certifying, when that line is visible, that it is always in the same position relative to the prism.

The author then proceeds as follows:—

I observed by day the solar spectrum, placing over the great lens a cloth, so fixed that it transmitted only the requisite quantity of light, and fixed the prism *p* to correspond to one or the other of the solar striæ; then fixing the telescope, I turned the movable bar, till one of its limbs touched the said stria at its minimum, and I read the corresponding division of the micrometer-screw. Leaving everything in this state, I turned the great lens in the evening to the star I wished to observe, and by the micrometer-screw immediately obtained the position of the stellar striæ, referred to the solar one observed in the morning. Besides the position of the stellar striæ, I have tried to determine the extremes of the spectra themselves, for which see Table.* I denote the striæ of the stellar spectra by the Greek letters, α, β, γ, proceeding from the least refracted end of the spectrum. The unlettered striæ have not been measured, but simply estimated, as being very difficult. I have grouped separately the separate-coloured stars, giving in each group the first place to the most conspicuous striæ, and so in order; classifying them from Humboldt's *Cosmos*, and Schmidt, in *Astr. Nachr.* The Table indicates that the stellar striæ have a certain relation to the star's colour. Thus the white stars seem to have a family likeness; and so the yellow, orange, and red ones. There is

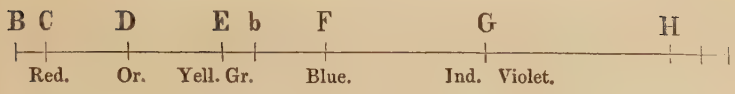
* See the figure, p. 103, roughly reduced from Prof. Donati's Memoir, and the numerical values, p. 104.— Ed.

likewise a great difference in the lengths. The three yellow stars have nearly the same maximum refraction end, but different minimum refraction ends; the reverse with the red stars. True, the measures of these ends (and indeed of the maximum refraction) are very uncertain, depending on the glass of the lenses and prism, and on the observer's eye. (Professor Amici has constructed a prism of very great dispersive power, without altering the axis of vision. It is composed of three prisms; the two outer ones of crown-glass, the inner one of boro-silicate of lead. Looking through this prism at a slit or luminous line, light is decomposed, with the same striæ as through a simple prism of flint-glass.) My prism was of flint-glass; refraction angle 60° 52′ 39″; angle of refraction of stria D of the solar spectrum (*i. e.* the angle which the refracted ray corresponding to D makes with the incident ray) is 49° 55′ 05″. The intermediate angles of the solar spectrum were found

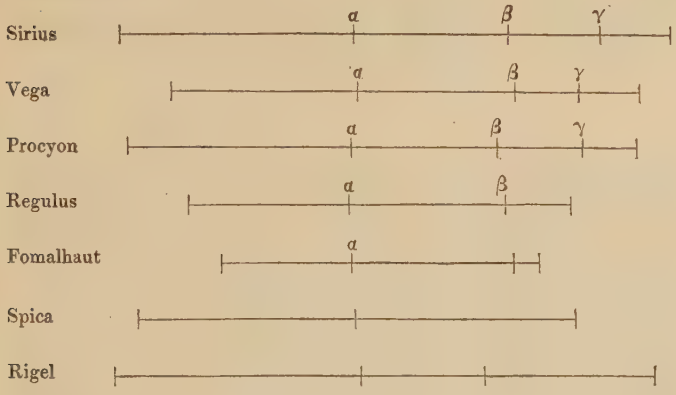
BC = 10′ 57″	Eb = 7′ 45″	FG = 72′ 9″
CD = 30 35	bF = 29 16	GH = 65 56
DE = 40 41		

All these angles I have measured by the theodolite as accurately as possible. The rim of the micrometer-screw = 11′ 5″; each of the 100 divisions of the head = 6″·65. Its movable bar was broad enough to be seen without illuminating the telescope; and I always placed the same limb in contact with the measured striæ. I observed when the star was close to the meridian, giving me more definite striæ; but we must not conclude that the striæ change with the altitude of the star; the horizontal scintillations naturally disturb the precision of the spectrum. Whilst observing, I tried to be in the dark as much as possible; ordering another to read the micrometers; for when the eye is fatigued, even by the feeble light of a lantern, it could not perceive the feeblest striæ of the stars. In cloudy or moonlight nights, the observations were uncertain and sometimes absolutely impossible. Although the great lens was not achromatic, yet, looking through the telescope at the slit illumined by the rays collected by the cylinder-lens, it appeared perfectly white and without perceptible coloured edges.

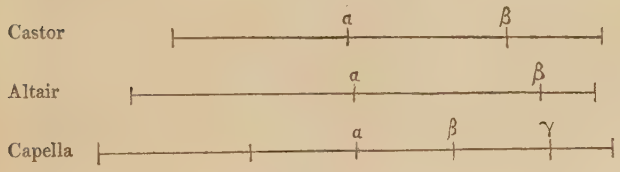
The following measures are the means of many observations thus obtained. Each star has its stria α referred to the solar F. Thus, for *Sirius*, $\alpha = F\odot - 15''$ means that *Sirius* α is refracted 15″ less than Sun F; and for *Vega*, $\alpha = F\odot + 40''$, that *Vega* α is refracted 40″ more than Sun F. $(r\alpha)$ means the angle between the minimum-refracted end of the stellar spectrum with its stria α; $(\alpha\beta)$, $(\beta\gamma)$, the angles between α and β, β and γ. (αv), (βv), (γv), are the angles made by α, β, and γ, with the maximum-refracted end v of its spectrum.



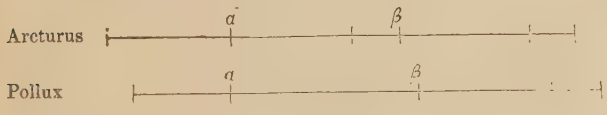
White Stars:—



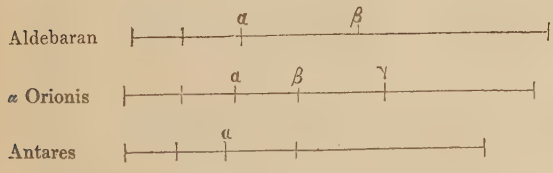
Yellow Stars:—

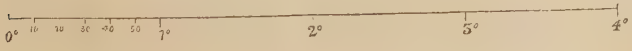


Orange Stars:—



Red Stars:—





A short description of each stria is appended, and its eye-estimated breadth referred to the micrometric bars. These said angles do not correspond to the central part of the striæ, but to their least refracted limb, which limb I always collimated with the movable bar of the micrometer. Thus *Sirius* α is refracted 15″ less than F Sun; but, since breadth of this $\alpha = 50''$, the central part of the said α is refracted 10″ more than F Sun. Similarly *Vega* $\alpha = F \odot + 40''$, breadth 40″, has its centre refracted 60″ more than F Sun, &c.

		$(r\alpha)$	$(\alpha\beta)$	$(\beta\gamma)$	(γv)
Sirius	$\alpha = F \odot - 15''$	85′ 40″	66′ 37″	42′ 27″	20′ 17″

α very fine, breadth 50″; β very fine, double, breadth 80″; γ as broad as α, faint.

Vega	$\alpha = F \odot + 40''$	77′ 15″	67′ 56″	34′ 55″	10′ 18″

α, β, very fine; α 40″, β 60″ broad; γ very broad, faint.

Procyon	$\alpha = F \odot - 33''$	78′ 55″	65′ 30″	37′ 1″	9′ 32″

α well seen, 15″ broad; β scarcely seen; γ ditto, rather broader than α.

Regulus	$\alpha = F \odot - 60''$	68′ 30″	66′ 17″	30′ 55″	—

α very clear, 20″ broad; β seen at intervals.

Fomalhaut	$\alpha = F \odot - 55''$	61′ 44″	70′ 36″	—	—

α fine, 35″ broad.

Castor	$\alpha = F \odot - 30''$	69′ 43″	62′ 4″	30′ 9″	—

α very fine, 40″ broad; β ditto, 60″ broad.

Altair	$\alpha = F \odot + 5''$	73′ 42″	66′ 3″	24′ 23″	—

α fine, 20″ broad; β indistinct, faint, 40″ broad.

Capella	$\alpha = F \odot - 2'\,40''$	81′ 1″	31′ 55″	34′ 35″	23′ 36″

α very thin, well observed; β, γ, scarcely visible, uncertain observation.

Arcturus	$\alpha = F \odot - 29'\,22''$	51′ 26″	44′ 27″	66′ 23″	—

α very thin, seen with trouble; β very difficult to be seen.

Pollux	$\alpha = F \odot - 28'\,42''$	47′ 33″	45′ 46″	68′ 56″	—

α very thin, seen with trouble; β very difficult to be seen.

Aldebaran α = F ⊙ − 22′ 29″ 50′ 39″ 29′ 40″ 64′ 17″ —

α very fine, 30″ broad; β somewhat thinner than α, very fine.

α Orionis α = F ⊙ − 30′ 35″ 50′ 19″ 17′ 24″ 16′ 51″ 57′ 18″

α very fine, 40″ broad; β very fine, 50″ broad; γ frothy, well seen.

Antares α = F ⊙ − 33′ 28″ 47′ 20″ 18′ 17″ 65′ 45″ —

α fine, 30″ broad; β rather fine, 20″ broad.

Now, comparing my results with Fraunhofer, there are very great differences. Thus, he says, *Sirius* has a very fine stria in the green, whilst I find this stria in the blue of the spectrum. He finds in *Pollux*, *Capella*, *α Orionis*, *Procyon*, a stria with the same position as D Sun, which line I have never seen. Perhaps attributable to the reason that the stellar light is never strong enough to distinguish the colours; saving a reddish tinge at the minimum-refraction end, they appear of a lavender tint in their whole length, which is always smaller than the solar one under the same conditions, from the great difference of light between the Sun and stars. If the stellar stria has not been measured, but merely eye-estimated (probably Fraunhofer's process), one may very easily get deceived, and mistake one stria for another. This occurred even to me at the beginning. Thus comparing the distance between the extreme red of *Sirius* and its α with that between the extreme red of the Sun, and E ⊙, I judged that α *Sirius* = E ⊙; but, passing to exact measures, I directly found that α *Sirius* = F ⊙.

Perhaps, as the stars change in colour, their stria-positions may change, or my more brilliant striæ may not have been the more brilliant ones to Fraunhofer's eye. (Thus Fraunhofer is silent on the difficulties of *Capella*, and speaks of the difficulties of *Procyon*. I found *Capella* very troublesome, and the stria of *Procyon* much clearer and sharper than any in *Capella*.) I merely point out the utility of making these observations at various times with the extremest accuracy, without hazarding any hypothesis.

However, I must remark that almost all my fifteen stars have a stria, very little differing from F ⊙. One may therefore presume that all these F-like striæ are constant, but with a greater or less refraction, from a difference in the refractive quality of the light of the particular star. On this hypothesis (partly agreeing with Fraunhofer's), it follows that the light of *Capella*, with a stria refracted 2′ 40″ less than F ⊙, must suffer a less refraction than the light of *Vega*, which is refracted 60″ more than F ⊙, whence the declinations of those two stars,

observed from two places, with very different (meridian) altitudes for each, must result differently. (Since $2' 40'' + 60'' = 220''$, and the refraction of F $\odot = 51^\circ 13' = 3073'$, with an horizontal refraction of $33'$. Hence the different refractions of these two striæ transferred to horizontal refraction $= \frac{33}{3073} + 220'' = 2''{\cdot}36$). I, therefore, compared Mr. Airy's *Cambridge Observations*, 1828–1835, with Mr. Henderson's, at the Cape of Good Hope, 1832–3 (*Mem. R. Ast. Soc.* vols. x. and xi.), which give these results:—

Camb.—C.G.H. 1830.		Mean Declination. Camb. 1830·0.	C.G.H. 1833·0.	A.P.M. in Decl.
$''$		$^\circ\ '\ ''$	$'\ ''$	$''$
+1·94	Fomalhaut	−30 31 13·92	30 19·1	−0·166
+1·71	Antares	−26 0 46·81	3 14·3	−0·034
+0·81	Sirius	−16 29 22·22	29 36·2	−1·198
+1·12	Spica	−10 16 15·60	17 13·7	−0·040
+0·57	Rigel	− 8 24 16·22	24 2·9	−0·012
−0·06	Procyon	+ 5 39 14·65	38 48·5	−1·023
+0·28	α Orionis	+ 7 22 3·72	22 7·1	+0·002
+1·32	Altair	+ 8 25 33·75	25 59·6	+0·380
+0·07	Regulus	+12 47 44·17	46 49·1	+0·006
−0·51	Aldebaran	+16 9 35·68	9 59·6	−0·174
+1·43	Arcturus	+20 4 16·41	3 18·0	−1·983
+0·72	Pollux	+28 25 45·50	25 20·4	−0·057
+0·49	Castor	+32 15 9·44	14 47·2	−0·078
+1·88	Vega	+38 37 50·56	37 57·7	+0·282
−2·00	Capella	+45 48 52·88	49 8·4	−0·425

I have extracted the Annual Proper Motion from vol. ii. p. 199, of *Annals of the Paris Observatory*. With them and the values in p. 181, to calculate the Precession, I have reduced the Cape Observations to 1830·0, whence I find as above. Whence *Vega* has at Cambridge a greater Declination than at the Cape of Good Hope, and *Capella* a less Declination at Cambridge. This seems to agree with my supposition, since *Vega* is low at the Cape with great horizontal refraction, and at Cambridge it is very high, with scarcely any refraction; and since the light of *Vega* seems from the above to be refracted more than the light of any other star, the refraction correction used at the Cape (which would increase the declination) is too small, making the star's declination less than that observed at Cambridge. The same horizontalities being verified for *Capella*, but, as contrary to *Vega*, the light of *Capella* is less refracted than that of *Vega*, the refraction correction

for the Cape of Good Hope must be too great for this star, causing a greater Cape of Good Hope declination than at Cambridge, as is the case. I chose the above two Catalogues, as being much esteemed and in approximate years: thus eliminating the uncertain influences of stellar Proper Motion. Also the stria *Vega* α is very fine, and *Capella* α, though thin and difficult, has been often observed by me with sufficient precision. This does not occur with Fomalhaut, which, rising to a very small altitude above Florence, and only seen for a short time, has been seldom observed by me, causing with its horizontal scintillations unreliable results. Indeed, my observations would lead to a contrary sign of the difference in declination between Cambridge and the Cape of Good Hope than to that which is actually obtained.

The sign for *Sirius* should be +, since the centre of its α is refracted 10″ more than F ⊙; the refraction correction applied to this star's observed place may be smaller than the true one, when the observed declination at Cambridge has not been increased enough, giving a smaller result at the Cape of Good Hope. The difference, *Altair* + 1″·32, also confirms my hypothesis; for, since the centre of its α stria is refracted 20″ more than F ⊙, one may suppose the horizontal refraction to be less than the true one, causing the Cambridge declination to be increased, and the Cape of Good Hope declination diminished; and, therefore, the former greater than the latter.

My measures are uncertain, more from the difficulty of hitting the exact stria-point than from the micrometer graduation stopping at 6″·6. The quickest way of reconciling the two Catalogues would be to make simultaneous observations at both places.

I would further recommend for observations of the stellar striæ a very large lens on Fresnel's principles for lighthouse lenses, as we do not so much require an image of achromatic sharpness as the concentrating of a great quantity of light, and such a lens would, perhaps, enable us to see as many stellar striæ as we find in the solar spectrum.

We further require to know the very small dispersive power in our atmosphere of the stellar light; also the stellar spectra breadth seen when near the horizon by a good telescope; also the maximum brightness point of various spectra. Such a series would be of first-rate value to modern Astronomy.

The second Memoir, dated February 1861, contains the author's observations of the Total Solar Eclipse of 1860, at Terrablanca, in Spain; and the third Memoir contains the Comet Observations at Florence, from 1854 to 1860.

Remarks upon the Phenomena attending the Disappearance, by Rotation, of the great Solar Spot of August 4th, 1862, as recorded by both Helio-photography and ordinary Telescopic Observation. By the Rev. F. Howlett.

Mr. Howlett, at the December Meeting, addressed the Society as follows:—

After the able remarks which have recently appeared in print respecting the comparative merits, in certain points, of celestial photography and telescopic observation—in connexion chiefly with the solar, and also the lunar surface—it might be deemed almost more than superfluous on my part to wish to bring the subject again before your attention this evening.

Mr. Dawes has alluded to the matter in a very instructive manner, both in an article which appeared in the *London Review* on the 18th of October last, and elsewhere; as also has Mr. Birt, in the columns of the same journal for Nov. 22 of the present year.

But the phenomena attending the disappearance, by rotation, of the very remarkable group of solar spots on the 4th of August last, and the observations then made, photographic and otherwise, in connexion with those phenomena, seem to bear so strongly upon one or two of the more *interesting* and at the same time most *warmly contested* points regarding the Sun's surface, that I hope I shall be pardoned for desiring to make you acquainted with the nature of a few of my own observations concerning the disappearance of this said group, as contrasted with the only photographic record of it which I have yet heard of, more especially since I was, I believe, the first to detect the discrepancy in this particular instance, in the course of a most interesting correspondence, which now for some little time has been maintained between Professor Selwyn and myself on such subjects; and I was permitted to make the case known in public on the 3d of October, before the members of the British Association assembled at Cambridge—as some here present may possibly remember.

It will of course be understood that it is in no carping spirit (which on every account would utterly unbecome me) that I venture to say that at times the photographic record may stand corrected by the simply telescopic one; the highest honours of this Society have recently, and doubtless most justly, been awarded to that distinguished member of our Society, whom we have now the great good fortune to own as one of our Secretaries, for his extraordinary success in applying the art of photography to celestial investigations of the highest interest; and earnestly do we all wish him every future success therein also, that both he and every lover of science could possibly desire.

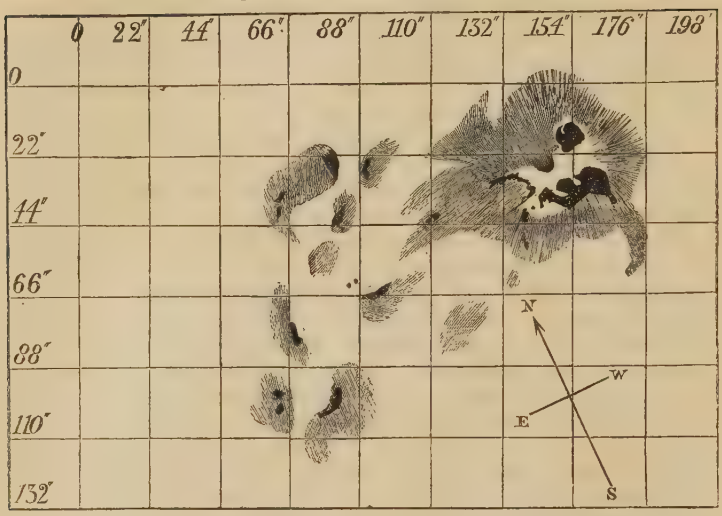
But not to be further tedious I would at once proceed to

remark, that the magnificent group in question (lettered ę in my record of Solar Spots), which passed off the disk on the evening of August 4th, was not observed by me before the afternoon of July 25th, by which time it had already advanced a considerable distance upon the Sun's surface. As seen near the centre of the disk, this group subtended about 4′ 30″ of arc, which would be equivalent to about 122,000 miles.

A carefully sketched series of drawings of the same, including twenty-two delineations, taken upon ten different days (and which are seen in sheets 83 to 86 inclusive), may be compared with the helio-autographs presented by Prof. Selwyn to the Royal Astronomical Society. Some of the drawings—those more particularly which illustrate the disappearance of the principal spot, and the photographic discrepancy on that occasion, have been re-copied in the diagrams on a scale of about ten feet to the solar diameter, which would give about four inches to one minute of arc, an amplification which, though not the best truly for distinct definition, may readily be obtained by the aid of a telescope of even not more than $2\frac{3}{4}$ inches aperture, and a power of about 160 diameters, by projecting the Sun's image upon a cardboard or other suitable screen, placed in a perfectly darkened chamber, at a distance of 8 feet from the eye-glass; and which arrangement enables me to observe and study the faculæ and solar surface generally, with remarkable facility and satisfaction. But the most effectual definition, amplification, and general management of the whole apparatus of both telescope, screen, and darkening shutter, are obtained in a simple but instructive method, by placing the screen on an easel, at the distance of about 4 ft. 2 in. from the eye-glass of my telescope—either one of the equatoreally mounted Sheepshanks' instruments, No. 4, belonging to the Royal Astronomical Society, $3\frac{3}{4}$ inches aperture, and 3 ft. 8 in. focal length, or a small Dollond of my own, of admirable definition and similar focal length, but of only $2\frac{3}{4}$ inches aperture, mounted upon a tripod stand, and armed with powers from 30 to 150 diameters. With a power of 80 diameters, the graduations of a kind of glass micrometer, ruled off into $\frac{1}{100}$ths of an inch, are seen beautifully projected upon a screen thus placed, (as also are any sun-spots or other solar phenomena that may chance to be in the field) each graduation meanwhile measuring half an inch in breadth, and comprising about 31 seconds of arc.

With regard, next, to the appearance of the group on July 25th, at $1^h\ 30^m$ P.M., I would direct attention to a remarkable mass of brilliant photospheric matter, at least 12,000 miles in length by 6,000 miles in breadth, (and embracing therefore a superficial area of not less than seventy-two million square miles), lying amidst the various associated nuclei of the principal spot, and completely insulated by a well-defined penumbra from the contiguous photosphere (fig. 1).

Fig. 1, 1862, July 25, 2·0 P.M.



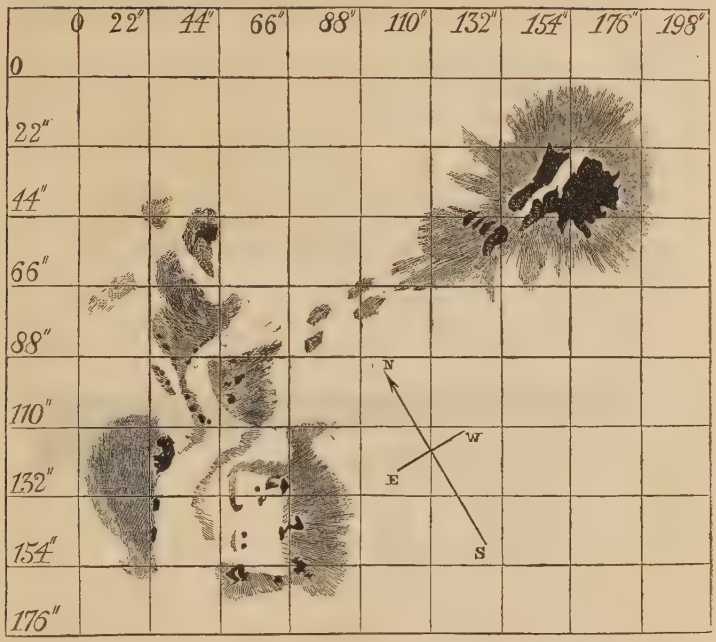
1″ = 466 miles.

On July 26th these nuclei had run into each other and become considerably enlarged, at the expense apparently of the bright patch; which last, either by sublimation, possibly, or a draining off sideways, or some kind of exhaustion, had become very much reduced in magnitude, as it was still more by $7^h\ 30^m$ A.M. on July 27th (see fig. 2), whilst, by $3^h\ 0^m$ P.M. on the same day, the patch was nearly obliterated, a slight hazy "bridge" alone remaining visible, and which in a feeble diffused form was faintly to be traced also on both the 28th and 29th July; but when I next observed the Sun on the 31st, this haze seemed to have entirely vanished. Some have thought that such a hazy film constantly accompanies a nucleus, but such is not my own impression. May not any extra appearance of haze be rather accounted for by the occurrence of phenomena similar to those which have just been described?

On July 31st, and August 1st, the great nucleus was grandly fringed by projections from the contiguous penumbral matter, often with sharp tooth-like terminations, and the disposition of the subordinate spots and patches of penumbra was also very interesting and instructive, as indeed they had been during the whole period of their apparition. But the highest point of interest, perhaps, in connexion with this group, exhibited itself on the occasion of the gradual disappearance round the western limb on the evening of August 4th.

On the preceding day, indeed, the group, and more especially the principal nucleus, might be seen to be remarkably foreshortened, and to be about to be divided again, apparently

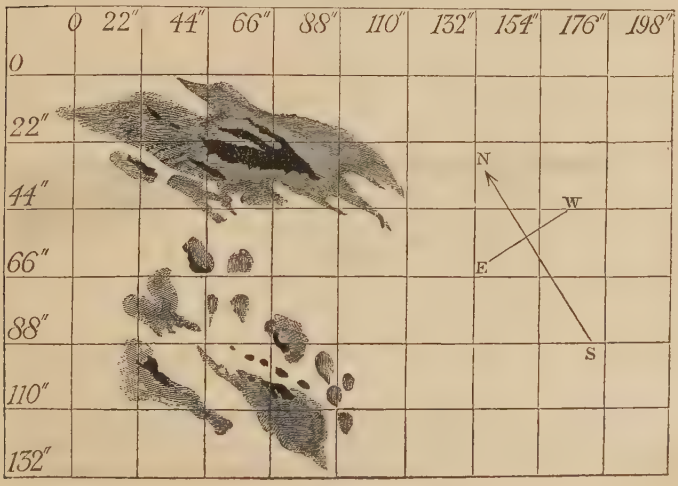
Fig. 2, 1862, July 27, 7·30 A.M.



1″ = 466 miles.

into two portions, by a sharply-defined and fresh "bridge," projecting across the chasm from the northern side (see fig. 3),

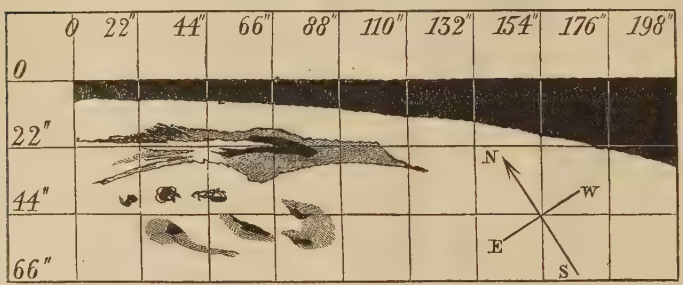
Fig. 3, 1862, Aug. 3, 6·40 A.M.



which feature (though springing then from the western side of the nucleus) had also characterised this spot during its earlier stages.

At $6^h\ 30^m$, on the morning of August 4th, the nucleus and "bridge," and many of the subordinate details, were still very distinct, though of course they were extremely attenuated, the nucleus then being, as nearly as I could judge, about twelve seconds of arc from the Sun's north-west margin; by far the greater portion of the penumbra, moreover, as Mr. Birt observed in his communication of October 20th last to the *London Review*, lying on its following or eastern side (see fig. 4).

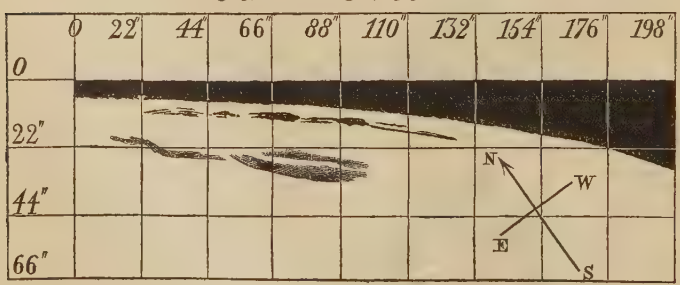
Fig. 4, 1862, Aug. 4, 7·0 A.M.



1″ = 466 miles.

By $3^h\ 50^m$ P.M., the nucleus, now reduced to a mere line, yet (owing to the admirable state of the atmosphere that day in east Sussex) *clearly* to be distinguished from its adjoining penumbra, could not have been more than from 3″ to 4″ from the limb, which latter, however, as yet, was certainly not broken (see fig. 5).

Fig. 5, 1862, Aug. 4, 3·50 P.M.

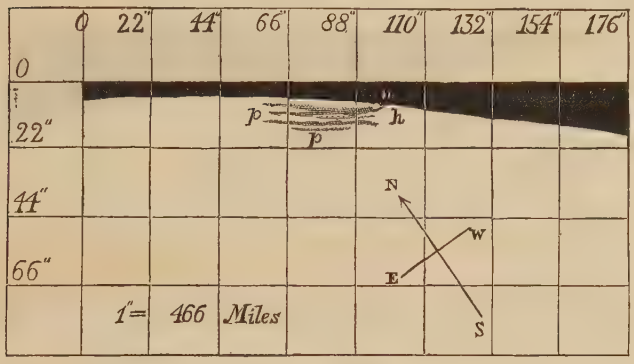


Pressing parochial business unfortunately prevented my observing the disk again till about 6 P.M., by which time the nucleus had completely disappeared, portions of its penumbra,

however, still remaining visible, as well as other patches of penumbræ adjoining.

And now it was that I am confident I could plainly perceive a *small notch* in the Sun's margin, precisely over the place where the great nucleus must have been existing (see fig. 6): and

Fig. 6, 1862, Aug. 4, 6 P.E.



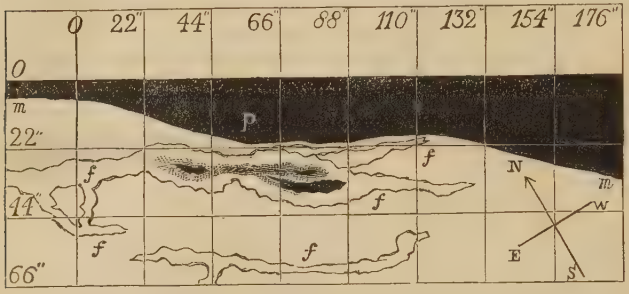
n, true notch in Sun's margin; *h*, hillock of facula; *p*, penumbral patches of great group.

it struck me that it was not caused so much by any deficiency in the circular limb of the Sun itself, but rather by reason of abnormally heaped up masses of the contiguous photosphere; which had perhaps been swept away, as it were, from the area occupied by the nucleus and penumbra, in like manner as a slight fall of snow might have been swept away from off a gravel path, and thus have been thrown up a little on each side. The portion of penumbra, in fact, which still remained visible, appeared to me to form the bottom of a shallow valley, seen obliquely over one of the elevations by which it was bounded, the right-hand, or south, bank (as seen in the inverted image) being the higher of the two.

Now all the foregoing observations had been communicated by me in a letter to Prof. Selwyn before I had any knowledge whether or no his photographer (Mr. Titterton, of Ely) had obtained "autographs" of the Sun on the day in question. A reply to my letter came to me shortly afterwards, in the form of two separate "autographs," taken respectively at the hours of $10^h\ 15^m$ and $11^h\ 30^m$ of the notable morning of August 4. But what struck me as very remarkable, was, that at the time when I had plainly observed and measured a brilliant streak of photosphere extending between the nucleus and the Sun's limb (and which I continued to observe and measure, at intervals, for nine hours afterwards), the autographs presented no appearance whatever of this streak, but

exhibited instead the appearance of a large notch or depression in the limb, approximately about 2′ of arc in length from N. to S., and 15″ or 16″ in depth from E. to W. See Fig. 7.

Fig. 7, 1862, Aug. 4, 10·30 A.M. (as represented in photograph).



1″ = 466 miles.

f stands for faculæ, P for pseudo gap in margin of Sun, *m* for normal margin of Sun; the subordinate spots only of the great group are yet visible, as shown in Figs. 4 and 5.

But this extraordinary depression, though hailed at the first by some of the advocates of the cavernous nature of the solar spots, as an almost triumphant proof of their views, went, as we have just seen, to prove *too much;* and, indeed, had the collodion been exposed to the solar rays for a somewhat longer period, in order that the comparatively dusky solar margin might have sufficiently depicted itself, no notch of any such dimensions (or, indeed, any notch at all) could possibly have appeared; and though Prof. Selwyn believes that this lengthened exposure would have spoiled, in all probability, the middle portions of the photograph (where, for instance, in sheet 86, the group lettered σ in my record is situated), yet in such a case it would only be requisite of course to take other negatives more especially adapted to the central parts of the disk.

Whilst on this part of my subject I would take the opportunity of mentioning that the helio-autographs of August 4th are not the only instances which present the appearance of such a pseudo-gap in the Sun's margin, whereby the existence of a large spot, when close to the limb, is completely ignored, sometimes.

Another such instance occurred in the photograph taken by Mr. Titterton on October 1st. Several of those who were attending at that time the meeting of the British Association, at Cambridge, would gladly have availed themselves of another of those rarely occurring chances of watching a large group fairly off the disk. Mr. Alexander Herschel did have such an opportunity at Collingwood, near Hawkhurst, that day, though

no notch was at any time apparent. Previously to leaving home I had requested Mr. Herschel to keep an eye on the group in question, and I received from him a letter, from which the following is an extract:—

"*Collingwood, Hawkhurst,*
"*Oct. 1st,* 1862.

"I send you in reply . . . a sketch of the Sun's appearance to-day. I missed the breaking of the white line, but the scale of the sketch, which is 1 inch to a minute, will show you that I saw it at $10^h\ 50^m$ A.M., to within 5 or 6 seconds of the Sun's limb, without any signs of the white line breaking."

And yet in the photograph taken that day at Ely the principal spot of the group is ignored, a shallow notch occupying its place, when, in point of fact, no such notch existed.

But notwithstanding any such discrepancies, allow me here to plead for the cavernous nature of the solar spots. For whilst jealously avoiding all desire to take any undue kind of argument from helio-photography, in its present stage, in support of the theory (which is also my own firm persuasion), that the solar spots are indeed cavities in the Sun's surface, I am not willing to be shaken in my belief that the photographic testimony bears most strongly in favour of that theory.

Photography, indeed, at times, would seem to wish to prove too much, as we said, but all its evidence, surely, runs in the same direction. It proves, surely, in agreement with the best eye observations, that the faculæ *undoubtedly* are raised billows or mountains, as it were, of photospheric matter, the crests of which (as Padre Secchi pointed out to me when lately at Rome) are necessarily not very visible when situated in the more *central* parts of the disk, where they are seen through the least perspective depth of the solar atmosphere, and where, in consequence, all similarly luminous photospheric matter, whether raised or otherwise, appears nearly alike brilliant; but which faculæ naturally exhibit themselves in far stronger relief towards the *marginal* portions of the disk, because that the rays which emanate from their lofty crests have to traverse, in their passage to our eyes, a far smaller amount of solar atmosphere than those rays have which emanate from their bases, and from the mean photospheric level above which the faculæ rise.

But may it not be argued thus, also, that not only are the faculæ elevations, but that the nuclei and penumbræ are depressions in the solar surface, and not clouds impending over it?

For if the solar spots were clouds, would they not (especially when anything like the size of the group of August 4th, 1862) exhibit much more frequent appearances of notches than they do?

They would surely be often seen in dark relief upon the Sun's limb, something after the way in which, at the beginning or close of a transit, the planets *Mercury* or *Venus* may be seen to produce an apparent indentation. And this appearance ought to take place, in the case of spots or groups of large magnitude, whether they were at a greater or less distance from the Sun's surface. Whereas, supposing them to be indeed cavities sunk in the spherical solar orb, then it seems clear that, even with the addition of the upheaved faculæ to enhance the effect, the phenomenon of a notch must be, *as it is*, exceedingly *rare*, and without the faculæ be well-nigh impossible.

But all the conditions requisite for forming the appearance of a small depression in the Sun's Limb were fulfilled on the evening of 4th of August. A group of unusual magnitude was passing off: there were mountain-like ridges of faculæ plainly conspicuous in the immediate neighbourhood of the same, and the eye of a spectator upon the earth would be looking along the shallow *trough* of the solar penumbræ, nucleus, and faculæ, in its greatest extent.

Another objection, finally, to the spots being cloudy masses appears to be this. Would it be possible for clouds to maintain such a comparatively *black tint* when immediately superimposed over the intensely incandescent surface (if it be incandescent, really, as well as brilliant) of the orb of the Sun?

RECENT PUBLICATION.

Sur deux Inégalités d'une grandeur remarquable dans les Apparitions de la Comète de Halley. Par A. J. Angström. (Extrait des *Actes de la Société Royale des Sciences d'Upsal*, Sér. iii. t. iv.) Upsal, 1862.*

The author remarks that Mr. Hind having succeeded in obtaining from the ancient accounts the appearances of Halley's Comet, as far back as the year 10 B.C., with considerable probability, he (M. Angström) was by these dates enabled to show the existence of two periodic Inequalities in the time of revolution of the Comet, surpassing as well in their magnitude as in the length of their period all the known Inequalities in the Planetary and Lunar Theories. The greater inequality, as regards the time of revolution of the Comet, is the more interesting, inasmuch as it depends on the known relation

* Mr. Carrington gave an account of this Memoir at the January Meeting, and he particularly called attention to the comparatively small amount of labour expended in obtaining such important results.—Ed.

(5 *Sat.* − 2 *Jup.* = 0 nearly) between the times of revolution of *Jupiter* and *Saturn*. The assumed data were—

Times of the Appearances of the Comet according to Mr. Hind.

− 10,20	451,50	912,25	1378,85
+ 66,07	530,84	989,70	1456,44
141,24	608,80	1066,25	1531,65
218,26	684,80	1145,30	1607,82 (N. S.)
295,25	760,44	1223,52	1682,70
373,84	837,26	1301,81	1759,19
			1835,87

thus comprising 24 complete revolutions, and giving a mean period

$$\tau = 76{,}92 \quad \text{Julian years};$$

or, taking the Julian year for the unit of time, the mean velocity of the Comet is $= 4^\circ\, 40' 48''{\cdot}72$.

Taking, then, the mean year 913,97 as the epoch, and the above value $\tau = 76{,}92$ as the mean time of revolution, this gives for the differences between the actual and calculated times of appearance, reckoned in Julian years, the series of values (already calculated by M. Mädler):—

−1,13	−0,95	−1,72	+3,27
−1,78	+1,47	−1,18	+4,04
−3,53	+2,51	−1,55	+2,31
−3,45	+1,59	+0,58	+1,48
−3,36	+0,27	+1,88	−0,46
−1,69	+0,21	+3,25	−0,89
			−1,13

These differences are laid down as ordinates in the plate annexed to the Memoir, the unit of distance for the abscissæ being the mean period τ, and that for the ordinates the half of a Julian year. And the form of the broken line joining the extremities of the ordinates, suggests the existence of the two inequalities (reckoned in Julian years):—

$$= 1{,}5 \sin\left((13\ \text{Com.} - 2\ \text{Jup.})\, n\tau + 13^\circ{\cdot}6\right)$$

$$\alpha\ 2{,}3 \sin\left((\text{Jup.} + \text{Sat.} - 9\ \text{Com.})\, n\tau + 231^\circ\ 1'\right)$$

the former depending exclusively on *Jupiter*, but the latter on *Jupiter* and *Saturn* conjointly.

A numerical discussion of the data by the method of least squares, on the foregoing basis, leads to the corrected formula for the time of appearance:—

$$A = 913{,}97 + n\tau + 1{,}4626 \sin\left((13\ \text{Com.} - 2\ \text{Jup.})\, n\tau + 19^\circ\, 14'{\cdot}3\right) + 2{,}1642 \sin\left((\text{Jup.} + \text{Sat.} - 9\ \text{Com.})\, n\tau + 233^\circ 39'{\cdot}1\right),$$

with the corrected value $\tau = 76{,}93$, and resulting value $4^\circ\, 40'\, 46''{\cdot}6$ for the period and mean annual velocity of the Comet; and then with Hansen's values,

$$\text{Jup.} = 30^\circ\, 20'\, 56''{\cdot}7, \qquad \text{Sat.} = 12^\circ\, 36'\, 16''{\cdot}1,$$

the numerical values for the arguments are found to be

$$13\ \text{Com.} - 2\ \text{Jup.} = 8'\, 10''{\cdot}4 = 2649{,}7\ \text{Jul. years} = 34{,}44\ \tau$$
$$\text{Jup.} + \text{Sat.} - 9\ \text{Com.} = 27'\, 15''{\cdot}2 = 782{,}38\ \text{,,} = 10{,}30\ \tau.$$

The final comparison of the formula with the data is found to present a very satisfactory accordance. The author remarks that by the combined action of the two inequalities, *the time of appearance of the Comet might be accelerated or retarded* from one revolution to another, *by about a year and a half.*

Minor Planet (76). Discovered by Dr. C. H. F. Peters, at the Hamilton College Observatory, 22d Sept. 1862.

The following elements, calculated by him, are given (*Ast. Nach.* No. 1399):—

Epoch 1862, Nov. 0·0, Washington M.T.

		°	′	″	
M	=	30	0	10·93	
π	=	334	40	12·13	Mean Equinox 1862·0.
Ω	=	359	52	19·09	
i	=	4	59	8·75	
φ	=	17	47	7·24	
μ	=			815″·1760	
log a	=			0·4258368	

Minor Planet (76) *Freia.* Discovered by Prof. D'Arrest, at Copenhagen, 14th Nov. 1862.

The following elements are given by him (*Ast. Nach.* No. 1397):—

Epoch 1862, Oct. 24·5, Greenwich M.T.

M	=	329° 35′ 4″·4	
π	=	94 5 52·1	Mean Equinox 1862·0.
Ω	=	213 58 4·3	
i	=	1 45 11·1	
φ	=	23 30 37·0	
log a	=	0·599052	
μ	=	448″·156	

A proposal has been made to form an Association for the Systematic Observation of Variable Stars. Members of the Society and others who may feel interested in the subject are respectfully requested to communicate with George Knott, Esq., Observatory, Cuckfield, Sussex, or Joseph Baxendell, Esq., 108 Stocks Street, Manchester.

Instruments to be disposed of.

A fine mahogany Telescope Tube suitable for a 7½-in. or 8-in. Object-glass, having a focal length of 9½ to 10½ feet; counterbalances, rackwork, illuminating apparatus, and finder; with a 2-in. object-glass, complete. This tube has been used for a 7½-in. object-glass, and was fitted up by Messrs. Dollond. Apply to Mr. Cooke, 31 Southampton Street, Strand, London, where the Tube may be seen.

The original Telescope and its Equatoreal Mounting of the late Dr. Pearson. The object-glass is nearly 7 ins. in diameter, and 12 feet in focal length. This Telescope is fully described and reported upon in the *Memoirs of the Royal Astronomical Society*, vol. ii. page 507. Apply to G. L. Prince, Esq. F.R.A.S., Uckfield, Sussex.

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